

TIERRAS OLVIDADAS: CHIRIBAYA LANDSCAPE ENGINEERING AND MARGINALITY IN SOUTHERN PERU

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The Peruvian south coast between the Tambo and Ilo rivers is a deserted wasteland. Yet tracts of abandoned farmland and expanses of desiccated lomas vegetation indicate that it was once vibrant and productive. Scattered habitations and cemeteries also indicate a pronounced resident Chiribaya population between A.D. 1200 and 1400. While river drainages of the western Andes and their canalized extensions are often treated as primary analytical units of study, our investigation of so-called peripheral intervalley regions points to a highly engineered and intensively managed landscape. When compared to the Ilo Valley, intervalley Chiribaya were organized into smaller communities and managed smaller spring-fed irrigation systems but were also heavily invested in adjacent maritime and lomas resource bases. Utilizing a mixed economic strategy, we argue, these intervalley populations were anything but marginal to the Chiribaya señorío of the Ilo region; rather, they were fully engaged in the social, political, and economic spheres of the late Intermediate period Peruvian south coast and formed a significant component of the Chiribaya cultural landscape. Our results hold implications for other similarly marginalized areas of the Andean coast, where distinct microenvironmental parameters and human ingenuity intersected to significantly transform the western Andes.

Aunque la costa entre los valles Tambo e Ilo en el sur del Perú es hoy día un gran desierto, los campos abandonados de cultivo junto con las extensiones de vegetación disecada de lomas sugieren que en tiempos antiguos era un paisaje vivo y productivo. Habitaciones y cementerios dispersos también indican una población Chiribaya muy marcada entre 1200 y 1400 d.C. Mientras que los drenajes principales de los Andes occidentales y sus extensiones canalizadas constituyen frecuentemente las unidades analíticas primarias de estudio, nuestra investigación de llamadas regiones periféricas entre valles sugiere un paisaje muy intensivamente manejado. En comparación al valle de Ilo, los Chiribaya entre valles se organizaron en comunidades más pequeñas y manejaron sistemas de irrigación más simples, pero a la vez invirtieron intensivamente en el manejo de los recursos adyacentes del mar y de las lomas. Utilizando una estrategia económica mixta, sugerimos que estas poblaciones entre valles no fueron marginadas, sino que estaban bien integradas en los círculos sociales, políticos y económicos del período Intermedio Tardío de la costa sur del Perú, y formaron un componente significativo del paisaje cultural Chiribaya. Nuestros resultados tienen importancia para otras regiones marginadas de la costa Andina, donde el cruce de parámetros microambientales particulares y la inventiva humana transformaron significativamente a los Andes occidentales.

Today, the intervalley coast between the Tambo and Ilo rivers is a desiccated landscape. Agriculture, largely supported by small desert springs, is restricted to only a few surviving farmsteads, while vegetation among inland hills has diminished considerably. Much of this intervalley coast is completely depopulated, with the vast majority of people currently living within the adjacent Tambo and Ilo river valleys. The area

is widely viewed to be an industrialized landscape with little value beyond a desert wasteland. In the 1960s, Southern Peru Copper Corporation (SPCC), Peru's largest mining operation, positioned its copper smelter along this stretch of coastline, where it was thought to pose the least possible detriment to human health and livelihood in the region (Hall 1992:55). Furthermore, since the port of Ilo largely expanded in the 1950s and 1960s as a company

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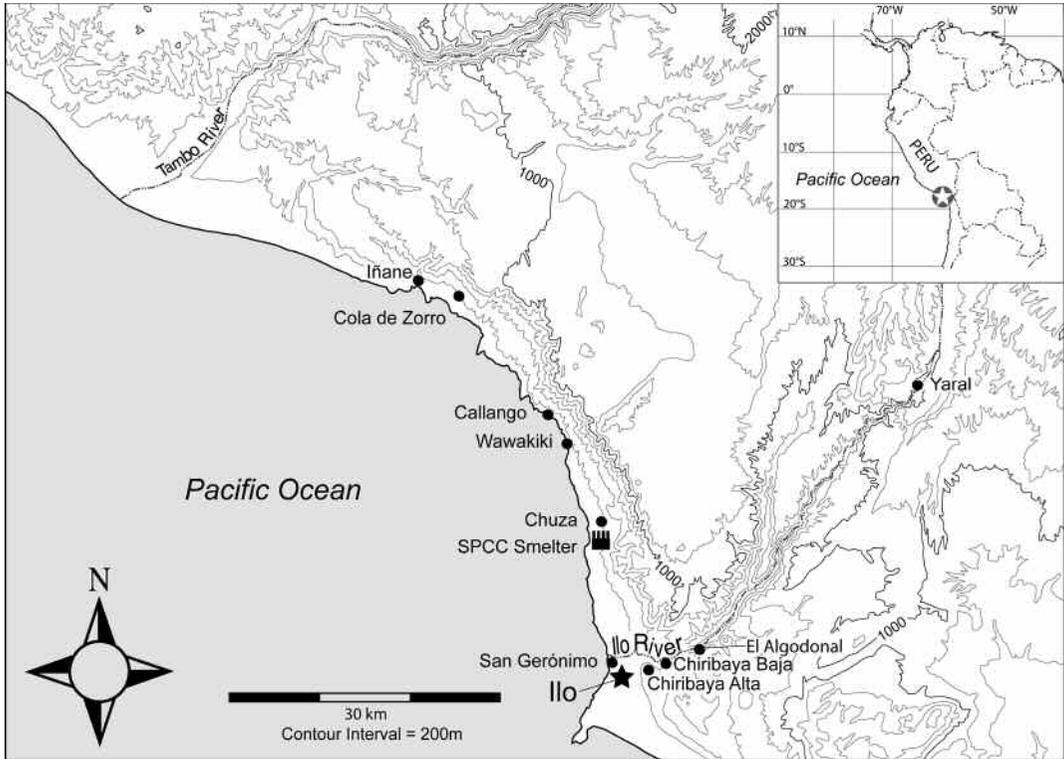


Figure 1. Map of the study region showing principal locations mentioned in the text.

town, few have historical connections to the area prior to the twentieth century, rendering the history of this distinctive landscape forgotten.

While in many respects the intervalley landscape may be considered “marginal” today, our research in these forgotten lands points to an impressive human component more than five centuries ago. Recent archaeological survey has identified a pronounced Chiribaya occupation beyond the hydrological limits of the principal river valleys. Indeed, scattered habitations, cemeteries, and the intensive management of coastal, agricultural, and *lomas* (winter fog/mist-fed vegetation) resources point to a highly engineered landscape between six and eight centuries ago. While earlier work confirms that Chiribaya populations were greatest along the Ilo River (e.g., Lozada and Buikstra 2002; Owen 1993, 1994, 2005; Umire Alvarez and Miranda 2001), we suggest that intervalley coastal peoples formed a significant component of Chiribaya—fully engaged in social, economic, and political spheres of the time—and were anything

but marginal. Studies of human populations past and present along the western Andean watershed have tended to rely upon primary river drainages and their canalized extensions as principal analytical units of inquiry. In this article, we propose that the investigation of so-called peripheral intervalley regions has the potential to significantly alter perspectives of ancient societies, ecological management, and contemporary landscapes of the arid Andean coast.

The Tambo–Ilo Coast

The Tambo and Ilo rivers constitute two of the southernmost valleys of Peru (Figure 1). Both course their way through hyperarid desert, transporting glacial meltwater and rainfall from the adjacent highlands to the Pacific coast. Farming currently dominates the landscapes of both valleys, though they differ substantially in production. Satellite imagery indicates that the Tambo Valley, with a much wider floodplain and greater annual

discharge, supports upward of 7,000 ha of irrigated bottomlands. On the other hand, the Ilo River flows through a narrower, steep-sided canyon that rarely reaches 450 m in width. In the late twentieth century, only 390 ha of land were under production (ONERN 1976), while satellite imagery indicates that cultivation still does not exceed about 400 ha today.

The rugged intervalley landscape separating these rivers is characterized by steep escarpments and deeply incised canyons, many of which descend from the adjacent Clesmesí Desert (1,200 m asl). Oceanic and topographic elements along the coast have maintained a relatively arid climate throughout the late Holocene, though punctuated by periodic flooding episodes associated with El Niño–Southern Oscillation (Fontugne et al. 1999; Keefer et al. 2003; Sandweiss et al. 2001). Marine records off the coast of central Peru indicate the occurrence of a Medieval Climatic Anomaly (A.D. 800–1250) with persistently weak El Niños followed by a period of moister conditions (Rein et al. 2004). In the current study area, however, Magilligan et al. (2008) have assembled a 20,000-year record of El Niño frequency from mid-valley tributaries of the Moquegua River.¹ They conclude that El Niño events increased in frequency and magnitude from about A.D. 700 to 1610 (when compared to the previous 700–800 years), with “mega-Niños” occurring around A.D. 1330 and 1650. Water geochemistry and isotopic data also suggest the important role El Niño plays in local aquifer recharge in this hyperarid environment (Magilligan et al. 2008:26–27).

Along the intervalley coast, the density of the archaeological record, and particularly as it pertains to agriculture between 800 and 600 years ago, suggests that there was considerably greater moisture and spring discharge during the late Chiribaya period (A.D. 1200–1400) than today, possibly resulting from centuries of elevated El Niño–induced aquifer recharge during and prior to that time (see Magilligan et al. 2008). Historical archives also indicate that the lomas among the inland hills were much lusher during the late prehispanic and early Spanish colonial periods than they appear today. Ethnohistorian María Rostworowski (1981), for instance, notes that the lomas around Ilo were some of the most productive in late prehispanic and early Spanish colonial Peru, while

eighteenth-century French explorer Amadeo Frezier (1982:156 [1713]) comments that the hills surrounding Ilo were once covered with trees but that these had receded because of deforestation. Elsewhere, Zaro (2005a, 2005b) suggests that this stretch of coast may have experienced increasing aridity since Chiribaya. Spring systems like Wawakiki witnessed a reduction in land use along with increasingly shorter and steeper canals over the past half millennium, while similar incremental reductions in land use are reported for neighboring springs like Carrizal (Clement and Moseley 1991). Ultimately, historic aerial photographs indicate that farming had ceased at Wawakiki prior to 1951 and well before the construction of the SPCC smelter (Zaro 2007:Figure 3).

The Concept of Marginality

By nearly any definition of the term, the Tambo–Ilo intervalley coast has become “marginalized,” a term applied regularly to human societies, fractions of human societies, or landscapes. As a cultural term, it is most often associated with the social, political, and/or economic exclusion of a particular group of people within a more broadly defined human demographic (Beattie et al. 1981; Binns 2007; Pollard 1997; Potter 2001). In this context it is synonymous with terminology like “undeveloped,” “unconventional,” “minority,” “impoverished,” “disenfranchised,” or even “third world.” In other instances, it relates to relative poverty or locations that are distant from centers of power and wealth (Pollard 1997). *Marginality* has also been applied to physical landscapes, referring to rural, distant, or peripheral regions. In other contexts, it reflects people’s conceptualization of harsh landscapes, evoking images of mountains, deserts, swamps, and even forests, depending on idiosyncratic values placed on such environments (Pollard 1997). Agro-ecological marginality, another physical application of the term, usually refers to the suitability of a landscape for farming (Beattie et al. 1981; Doolittle 1988; Waldhardt et al. 2001; Wu et al. 2001). In this regard, it is tantamount to concepts like “unpredictable,” “undesirable,” and “adverse conditions” or even land that requires intensive investment to achieve similar productivity to “optimal” lands. Referring to cultivated landscapes in eastern Sonora, Mexico, Doolittle

(1988:255) notes that marginality is often associated with intermittently farmed terrain. He also points out that marginal lands are routinely dichotomized with those thought to be optimal for agriculture. However, as Doolittle (1984) has also demonstrated, intermittent farming can gradually lead to permanent cultivation with the accumulation of incremental changes over time.

A number of studies also hint at what we term “scholarly marginality,” or the lack of scholarly inquiry pertaining to either sociocultural or agro-ecological concerns due to the perceived unimportance of a people or landscape. In geography, Potter (2001) describes underdeveloped nations to be marginal in the sense that they receive little attention and are afforded far less importance when compared to urban–rural landscapes of North America and Europe. Similarly, Doolittle (1988) attributes the lack of scholarly attention to intermittently cultivated fields in Sonora, Mexico, to their perceived unimportance. Elsewhere, Binns (2007) suggests that marginality can even be applied to geographical trends in scholarly publication. He notes that journals published in so-called marginalized regions like Africa or Latin America, for example, receive far fewer submissions for publication than do those published in less marginalized Europe and North America, even when the scientific focus of those manuscripts is centered on those marginal regions. Consequently, these areas remain underrepresented with respect to the distribution and control of a knowledge base constructed from their lands and people.

Whether applied to socioeconomic status, to physical landscapes, or to trends in scholarly inquiry and publication, marginality is clearly not a fixed condition but, rather, may be applied subjectively in a range of contexts and vary as socioenvironmental conditions change. The current state of the Tambo–Ilo coast would certainly qualify it to be marginal according to most definitions. In many cases, freshwater springs that once irrigated prehispanic and Spanish colonial farmsteads have dried up completely, while others have significantly diminished, reducing the area’s overall biological potential. The southern half of the coastline is dominated by the SPCC copper smelter, though several olive groves established during the Spanish colonial period still cling to the margins of a few spring channels. Only a handful of people continue to live

perennially along this coastline today, maintaining subsistence primarily from small-scale spring-fed irrigation agriculture, fishing, and pastoralism. The inland lomas are also highly desiccated, which may be linked to wider processes of desertification (including human agency) over the past 600 to 1,000 years, though this continues to be the focus of an ongoing investigation (Zaro 2008a; Zaro et al. 2008). Agro-ecologically, the intervalley region offers little to the farming economy of the Peruvian south coast, and with little infrastructure beyond a rocky, pockmarked road that parallels the coastline, the few farmsteads that do survive in the area have little opportunity to integrate with regional economies.

The Chiribaya *Señorío* and the Peruvian South Coast

This bleak picture of the intervalley coast, and particularly its lack of infrastructure and biological potential, has left it relatively absent from archaeological inquiry when compared to work carried out along the Ilo River. In the 1980s and 1990s, archaeological research performed under the auspices of the Programa Contisuyo in Moquegua, Peru, focused primarily upon human occupation of the Osmore drainage (e.g., Watanabe et al. 1990) but with collaboration among colleagues throughout southern Peru, Bolivia, and northern Chile to provide a broader cultural context. Central to this article, the research program and its collaborators documented a moderate distribution of late Intermediate period (ca. A.D. 900–1400) Chiribaya ceramic styles in the region, ranging from limited quantities as far inland as the Upper Osmore drainage (Stanish 1992) to as far north as the Tambo River and as far south as northern Chile (Jessup 1990). However, Owen’s (1994) systematic survey of the Lower Osmore drainage identified by far the most abundant Chiribaya remains, indicating that it was primarily a coastal valley phenomenon. Chiribaya settlement stretched inland 25 km from the river’s mouth, reflected in habitation sectors, midden scatters, mortuary remains, and agricultural fields scattered along the margins of the Ilo River. By A.D. 1000, the socioenvironmental landscape of the lower drainage largely consisted of Chiribaya farming villages situated along the floodplain of the river. Chiribaya also engineered a 9-

km-long canal along the north canyon wall to irrigate a series of hanging river terraces (Reycraft 2000:99). Closer to the Pacific Ocean, Chiribaya fishing villages like San Gerónimo exploited rich fisheries off the Andean coast (Jessup 1990).

Following ethnohistorian María Rostworowski's model of horizontality, Lozada and Buikstra (2002, 2005) have interpreted the Chiribaya to be a *señorío*, composed of specialized groups of *labradores* and *pescaores* who operated under the rule of a supreme authority, perhaps situated at Chiribaya Alta. They draw upon archaeological and bioanthropological data sets generated principally from Ilo Valley populations to support their conclusions. Elsewhere, research centered on small coastal villages immediately north and south of Ilo has also provided glimpses of the complexity and variability of late prehispanic socioeconomic organization (Bawden 1989; Clement and Moseley 1991; Covey 2000; Miranda and Umire Alvarez 2007; Reycraft 1998; Satterlee 1993; Satterlee et al. 2000; Umire Alvarez 1994, 1996; Zaro 2005b, 2007; Zaro and Umire Alvarez 2005). In particular, an emphasis on diversified economic strategies may have been the norm among intervalley coastal villages, while river valley populations may have favored the moderately specialized approach argued by others (i.e., Lozada and Buikstra 2002). At Wawakiki, which lies on a rocky sea cliff with access to a sandy beachfront, Zaro and colleagues identified intensive stone-faced agricultural terraces that were once irrigated by multiple spring systems (Zaro 2007; Zaro and Umire Alvarez 2005). Agricultural fields were associated with Chiribaya habitation terraces and domestic middens dense with marine shell. The presence of camelid dung may also indicate that the nearby lomas were of some importance to this small village. Zaro (2007) argues that the proximity of maritime, agricultural, and lomas resources to a single community may have encouraged this explicitly diversified subsistence strategy.

In general, however, scholarly understanding of the strength of Chiribaya cultural expression among intervalley arenas has sorely lagged behind that of river valley populations and been limited to those freshwater springs in proximity to Ilo. Consequently, the human component among intervalley landscapes has thus far been poorly understood and appeared to be insignificant when compared to that

of primary river drainages of the Peruvian south coast.

Engineering a Landscape: The Tambo-Ilo Intervalley Coast

Following informal reports of extensive archaeological remains in the region, we recently carried out a systematic archaeological survey of the Tambo-Ilo intervalley coast. The project was designed to document all human activities in the material record, generally from the mid-Holocene through the twentieth century. The survey followed the coastline northward from Wawakiki to Quebrada Iñane, extending Umire Alvarez's (1994, 1996) previous work between Wawakiki and Ilo (Figure 1). Our investigation also reached inland to elevations of approximately 800 m asl. While Spanish colonial, republican-era, and twentieth-century activities are certainly notable across the landscape, the most pronounced record over the past several millennia appears to relate to late Chiribaya (A.D. 1200–1400) settlement located predominantly within coastal canyons below 250 m asl. In addition, a much more ephemeral late prehispanic archaeological record is found among the now-desiccated lomas of the inland hills.

Given the paucity of excavation data from intervalley contexts, we recognize that we cannot reject outright the possibility of seasonal occupation of this zone or perhaps interannual movements of people from the valley (during El Niño-related rainfall events, e.g., when lomas often expand). However, the regular association of formally bounded cemeteries with agricultural fields and habitation sectors among intervalley springs would strongly suggest a degree of territoriality and likely permanent, rather than seasonal or interannual, occupation. Furthermore, while Knudson and colleagues (2007) have demonstrated seasonal variation in diet among some Ilo Valley Chiribaya regarding the consumption of marine products and C_4 plants like maize, the potential for both resource bases existed along the intervalley coast and would not have necessitated the seasonal movement of people (see Zaro 2007). Therefore, we suggest that the material expression of landscape engineering along the Tambo-Ilo coast reflects a relatively permanent occupation during the late Chiribaya period. Our discussion focuses on agricultural and

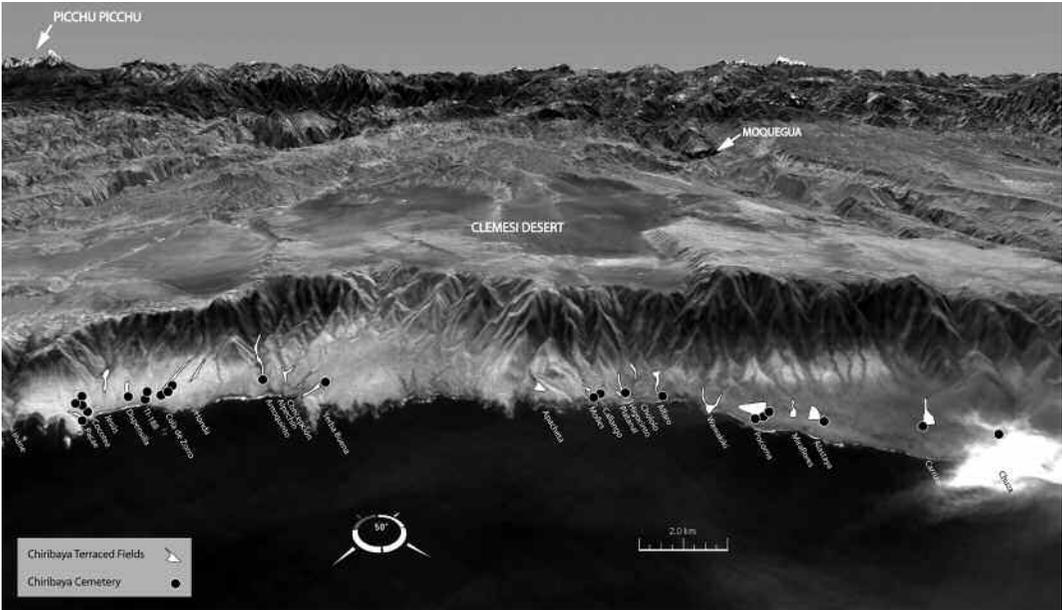


Figure 2. Three dimensional model of a portion of the Tambo-Ilo intervalley coast showing the local topography and the distribution of the agricultural and mortuary landscapes. Oblique satellite image produced from NASA World Wind 1.4. Vertical elevation is exaggerated 3x.

mortuary components identified in these areas and their pertinence to a reinterpretation and greater appreciation of these often-overlooked segments of cultural landscapes in the western Andes.

Intervalley Chiribaya Agriculture

Intensive Chiribaya canal and terrace agricultural technologies were identified in 23 intervalley coastal canyons (Figure 2). The chronological affiliation of agricultural remains is assessed using a variety of absolute and relative measures across the region, which include radiocarbon age ranges produced directly from field systems and associated domestic sectors (Figure 3), superposition of Huaynaputina volcanic ash from A.D. 1600 (see Thouret et al. 1999), and the presence of Chiribaya ceramic forms and styles identified in related domestic and mortuary contexts (following Jessup 1990, 1991; Owen 1993). A summary of chronological information for intervalley Chiribaya sites is provided in Table 1.

Agricultural Strategies. Terraced field systems were engineered along canyon margins and across desert pampas, and they were irrigated with canals that transported water to field systems from inland springs, anywhere from several hundred meters to upward of 2 km away. Terrace construction varied

in form and size, largely reflecting the influence of local topography. Most terraces, however, range from .5 to 1 m in height and are faced with stacked blocks of pink granite, the most abundant rock type along the intervalley coast for such constructions (Fortin 2008). In some cases, terraces were con-

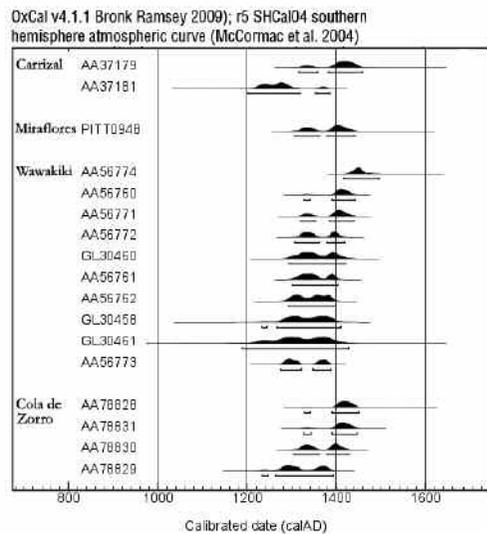


Figure 3. Calibrated radiocarbon ages. Probability distributions (with 2σ brackets) were produced with OxCal 4.1.1 (Bronk Ramsey et al. 2009) using a southern hemisphere atmospheric curve (McCormac et al. 2004). See Table 1 for sources of radiocarbon dates.

Table 1. Basis for Late Prehispanic Chiribaya Chronology of Intervalley Coastal Springs. Documented Cases of Superimposed Huaynaputina Ash and Reported Radiocarbon Ages Stem from Those Sites Where Archaeological and/or Geological Work Has Been Performed.

Location	Basis of Chronology			References
	Superimposed Huaynaputina Ash (A.D. 1600)	Uncalibrated Radiocarbon Ages (B.P.)	Additional Observations	
Chuzza	Documented		Chiribaya ceramic forms/styles from domestic and mortuary contexts	Miranda and Umire Alvarez 2007 Umire Alvarez 1996
Carrizal	Documented	AA37179, 561 ± 51 AA37181, 785 ± 48	Stone terraces; Chiribaya ceramic forms/styles from domestic contexts	Clement and Moseley 1991 Owen 2005* Reycraft 1998 Satterlee 1993
Alastaya			Chiribaya ceramic forms/styles from domestic contexts	Umire Alvarez 1994
Miraflores	Documented	PITT0948, 600 ± 45	Chiribaya ceramic forms/styles from domestic contexts	Satterlee 1993* Umire Alvarez 1994
Pocoma	Documented		Chiribaya ceramic forms/styles from domestic contexts	Satterlee 1993 Umire Alvarez 1994
Wawakiki	Documented	AA56774, 480 ± 30 AA56760, 575 ± 31 AA56771, 592 ± 35 AA56772, 627 ± 30 GL30460, 640 ± 50 AA56761, 651 ± 32 AA56762, 685 ± 33 GL30458, 700 ± 60 GL30461, 720 ± 90 AA56773, 727 ± 30	Stone terraces; Chiribaya ceramic forms/styles from domestic contexts	Zaro 2007* Zaro and Umire Alvarez 2005*
Alfaro			Stone terraces; Chiribaya ceramic forms/styles from domestic and mortuary contexts	Umire Alvarez 2006
Chololo	Documented		Stone terraces; superimposed debris flow	Umire Alvarez 2006
Higocinto			Stone terraces; Chiribaya ceramic forms/styles from domestic and mortuary contexts	Umire Alvarez 2006
Platanal			Stone terraces; Chiribaya decorated ceramics from adjacent domestic contexts	Umire Alvarez 2006
Callango			Stone terraces; Chiribaya ceramic forms/styles from domestic and mortuary contexts	Umire Alvarez 2006
Molles			Stone terraces; Chiribaya ceramic forms/styles from domestic and mortuary contexts	Umire Alvarez 2006
Apacheta			Stone terraces; Chiribaya ceramic forms/styles from domestic contexts; One Inca decorated ceramic fragment	Umire Alvarez 2006
Yerba Buena			Chiribaya ceramic forms/styles from domestic and mortuary contexts	Umire Alvarez 2006
Concepción			Stone terraces	Umire Alvarez 2006
Alpechín			Stone terraces	Umire Alvarez 2006
Amoquinto			Stone terraces; Chiribaya ceramic forms/styles from domestic and mortuary contexts	Umire Alvarez 2006
Honda			Stone terraces; Chiribaya ceramic forms/styles from domestic contexts	Umire Alvarez 2006
Cola de Zorro	Documented	AA78828, 560 ± 36 AA78831, 569 ± 36 AA78830, 617 ± 36 AA78829, 735 ± 44	Stone terraces; Chiribaya ceramic forms/styles from domestic and mortuary contexts	Umire Alvarez 2006 Zaro 2008b*
Dispensilla/TI-188			Stone terraces; Chiribaya ceramic forms/styles from domestic contexts	Umire Alvarez 2006
Jesús			Chiribaya ceramic forms/styles from domestic contexts	Umire Alvarez 2006
Pacae/Cocotea			Stone terraces; Chiribaya ceramic forms/styles from domestic and mortuary contexts	Umire Alvarez 2006

* Reported Radiocarbon Ages.

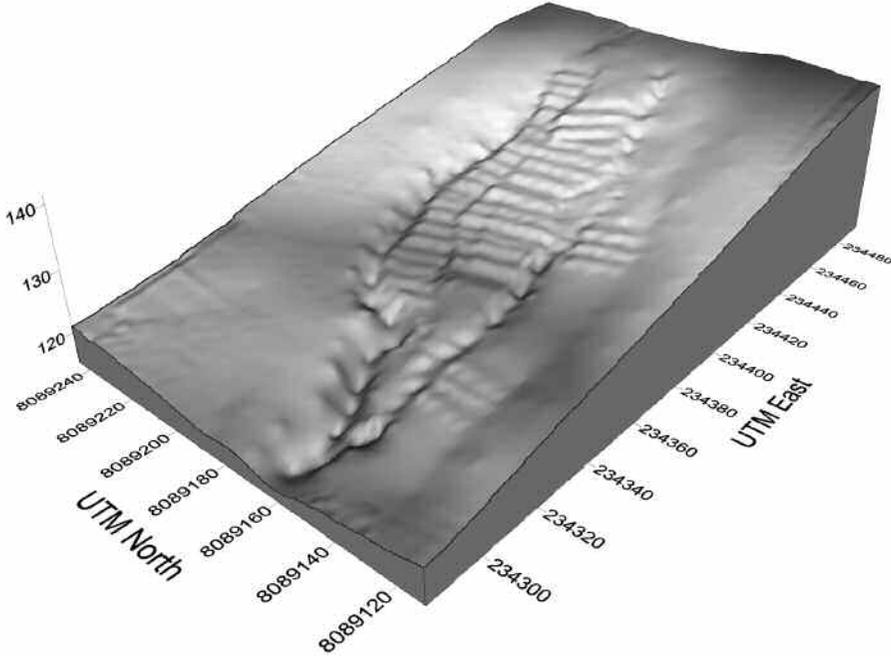
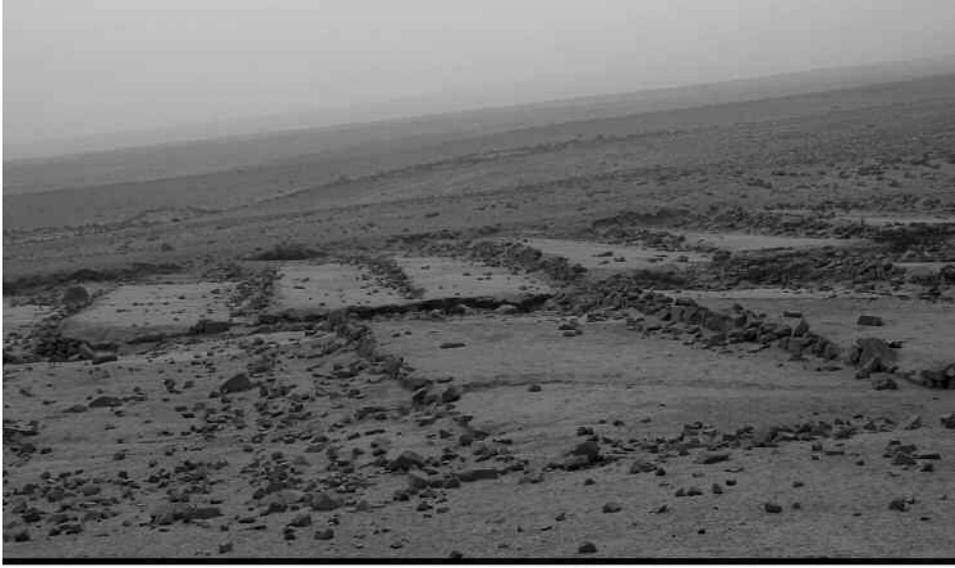


Figure 4. Photograph and surface map produced from a section of late prehispanic channel margin terraces at the Cola de Zorro archaeological site along the Tambo-Ilo coast.

structed along the margins of drainage channels (Figure 4) in similar fashion to what have been termed “valley floor terraces,” or low-walled bench terraces found perpendicular to stream channels on valley floor areas (Treacy and Denevan 1994:100–101). In other cases, small discontinuous sets of terraces are situated across stretches of desert pampa between coastal drainages. Canals are

lengthiest in such cases, where it became necessary to first channel water out of deeply incised canyons and subsequently transport it across the desert to distal field systems. Whether along the margins of drainage channels or dispersed across the desert, Chiribaya farmers often included an element of what may be termed “grid” terracing—sets of roughly equilateral quadrangles that follow sub-



Figure 5. Grid terraces at the Apacheta archaeological site along the Tambo-Ilo coast. Each quadrangle measures approximately 12 m per side.

tle changes in topography (Figure 5). Commenting on morphologically similar (albeit much more extensive) fields along the Ilo River, Williams (1997:114) notes that this type of field organization is unique in the Osmore region and may reflect some degree of central planning by Chiribaya elite. While central organization does not appear to have been necessary to construct the much smaller terraced field systems of the intervalley coast, their presence indicates that coastal and main valley populations shared similar engineering principles.

Extent of Agrarian Production. In general, intervalley Chiribaya irrigation systems were relatively small scale when compared to the construction and management of a contemporaneous 9-km-long canal and its associated field systems along the Ilo River (Reycraft 2000:99). Over the past few decades, the Ilo Valley has supported about 390 ha of irrigated floodplain (ONERN 1976:276; and satellite imagery), while during the Chiribaya period, we generously estimate from satellite

images that an additional 75 ha of irrigated farmland could have been supported by the canal. When compared to the Middle Moquegua Valley of the late twentieth century (2,810 ha) or the Tambo Valley (estimated 7,000 ha from satellite imagery), the Ilo River has never irrigated more than just a modest amount of terrain, yet it was home to the largest of Chiribaya populations known to date and arguably central to Chiribaya sociopolitical authority. In contrast, the most extensive intervalley spring system was Pocoma, which encompassed a maximum of about 30 ha of cultivated terrain (Satterlee 1993). Most intervalley systems, however, operated on an even smaller scale, ranging anywhere from 1 to 15 ha in size. While these intervalley agro-engineering projects may seem insignificant on their own, combined they produced nearly 200 ha of canal and terrace farmland (Table 2, Figure 6). Furthermore, our calculations do not include potentially cultivated land from intervalley spring systems north of our survey area between Quebrada

Table 2. Areal Extent of Chiribaya and Modern Agricultural Land Use in the Ilo Region.

Location	Intervalley Chiribaya (ha)	Ilo Valley, Chiribaya (ha)	Ilo Valley, Modern (ha)	References
Chuza	3			Umire Alvarez 1996
Carrizal	26			Satterlee 1993
Alastaya	15			estimate from satellite imagery
Miraflores	18			Satterlee 1993
Pocoma	30			Satterlee 1993
Wawakiki	11			Zaro and Umire Alvarez 2005
Alfaro	5			Umire Alvarez 2006
Chololo	2			Umire Alvarez 2006
Higocinto	6			Umire Alvarez 2006
Platanal	1			Umire Alvarez 2006
Callango	6			Umire Alvarez 2006
Molles	2			Umire Alvarez 2006
Apacheta	8			Umire Alvarez 2006
Yerba Buena	8			Umire Alvarez 2006
Concepcion	2			Umire Alvarez 2006
Alpechin	4			Umire Alvarez 2006
Amoquinto	17			Umire Alvarez 2006
Honda	5			Umire Alvarez 2006
Cola de Zorro	12			Umire Alvarez 2006
Dispensilla	3			Umire Alvarez 2006
Jesus	10			Umire Alvarez 2006
Pacae	1			Umire Alvarez 2006
Ilo Valley (Chiribaya)		465		ONERN 1976, plus estimate from satellite imagery
Ilo Valley (Modern)			390	ONERN 1976
Total (ha)	193	465	390	

Note: Ilo Valley chiribaya land use is estimated from satellite imagery based on relic fields associated with 9-km long canal along the north canyon wall and modern irrigation of floodplain.

Iñane and the Tambo River (an additional 25 km of coastline). Nor do they include potentially cultivated fields among the inland hills, where there is substantial evidence for twentieth-century agricultural furrows indicative of dry farming between 500 and 800 m asl. A local farmer and longtime resident of the intervalley coast confirmed that 30–40 years ago he would expediently plant potatoes and other cultigens among the inland hills, noting that the seasonal *garúa* (winter fog and mist) was at times dense enough to support such activities. While we did not identify any direct surface evidence of Chiribaya dry farming, the ephemeral nature of the late prehispanic and Spanish colonial archaeological records among the inland hills mimics the equally scant modern material record, suggesting that similar activities may have transpired periodically in antiquity. When joined with terraced landscapes of lower canyon lands and potentially irrigated farmland in unsurveyed regions north of our study area, 250 ha of cultivable terrain during

the late Chiribaya period is not an unreasonable estimate for the intervalley region. This would have constituted more than 50 percent of the maximum extent of contemporaneous land use along the Ilo River. Add this to a lomas base described to be one of the most productive in late prehispanic and colo-

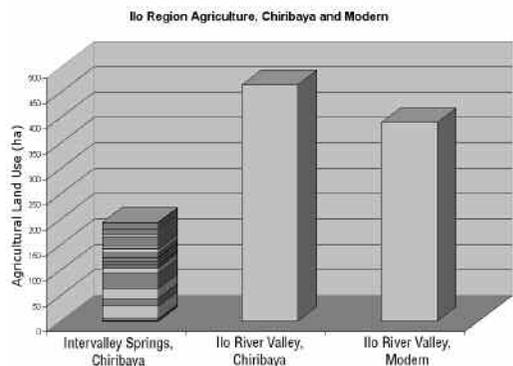


Figure 6. Comparison of estimated cultivation (ha) among intervalley Chiribaya, Ilo Valley Chiribaya, and Ilo Valley agricultural landscapes of 1976.

nial Peru (see Rostworowski 1981) and to one of the world's richest fisheries, and a picture of a highly engineered landscape emerges—far from the marginalized industrial landscape observed today.

Chiribaya Mortuary Remains

While the archaeological record points to a significant agricultural landscape along the intervalley coast during the thirteenth and fourteenth centuries, numerous middens, habitation terraces, and mortuary remains also indicate a fairly pronounced resident Chiribaya population associated with the management of field systems and marine resources (see also Zaro 2007). Our discussion here focuses on the mortuary component of the intervalley landscape, where a total of 24 discrete Chiribaya cemeteries have been identified from surface remains (see Figure 2).² Comparing the mortuary landscapes of the intervalley region with those of the Ilo Valley permits some assessment of relative population sizes and the socioeconomic identity of intervalley populations.

Chiribaya Cemeteries and Relative Population Size. All intervalley cemeteries discussed here were at least partially looted and identified from surface scatters of human bone and fragments of ceramics, textiles, slab stones, and other mortuary remains. In some cases, tomb constructions are visible within looters' excavations and indicate the presence of stone-lined rectangular and circular pits (Figure 7). Intervalley cemeteries are positioned along the margins of drainage channels or on immediately adjacent desert pampas or small crests, and all are situated near habitation features (terraces or structures) and extensive scatters of domestic debris that include fragments of ceramics, lithics, and marine shell. In several instances, multiple discrete cemeteries are located in proximity to each other along a single drainage. Cemetery areas are measured by the visible extent of looting, with most encompassing very modest areas ranging from less than 100 m² to about 2,000 m². However, the two largest cemeteries along the intervalley coast measure 8,576 m² and 3,630 m², both of which are found at the site of Callango near Quebrada Molles (see Figure 2).

In contrast to the intervalley coast, Bruce Owen's (1994) archaeological survey of the Lower Ilo Valley documented slightly fewer Chiribaya

cemeteries overall,³ but they were much more extensive on average, ranging from less than 800 m² to over 14,000 m². In total, 18 demonstrably Chiribaya cemeteries were identified in the lower valley, with two additional Chiribaya cemeteries identified at El Yara in the lower portion of the middle drainage. Chiribaya were most numerous along the Ilo River, but when combined, intervalley coastal populations (represented by bounded or clustered cemetery areas) constituted about 32 percent of the total measured in the lower valley, suggesting that these communities formed a pronounced (though somewhat dispersed) component of the Chiribaya cultural landscape (Table 3, Figure 8).

The Chuza Site and Expression of Socioeconomic Identity. To date, only one intervalley Chiribaya cemetery has been excavated. Located at Quebrada Chuza behind the SPCC smelter (see Figure 2), it was excavated in its entirety as a salvage project in the face of modern construction activity (Miranda and Umire Alvarez 2007). The site is predominately Chiribaya and suitably positioned to have managed maritime, agricultural, and lomas resources. Overall, 108 intact or disturbed tombs were excavated, with 97 single interments and 11 double interments. Tomb construction varied but included rectangular, circular, and irregular stone-lined and unlined pits. Burial accompaniments included ceramic vessels, textiles, and other artifacts crafted of metal, ceramic, wood, stone, and bone. Our discussion is based on Chuza cemetery data initially published by Miranda and Umire Alvarez (2007).

While the mortuary analysis presented in this article is preliminary, it is interesting to consider the context (residential vs. midden), construction form, and grave contents of tombs at Chuza in light of the established relationship between these variables and ethnic group membership among Chiribaya inhabiting the Ilo Valley. Evidence from a number of different attributes, including differential distribution of tomb forms (Buikstra 1995), cranial modification styles (Hoshower et al. 1995; Lozada and Buikstra 2005), and biochemical analyses of skeletal material (Tomczak 2003), points to a degree of economically specialized ethnic groups (Buikstra 1995). More broadly, the context in which the ancestors are interred speaks to resource control and, by extension, regional sociopolitical interactions.

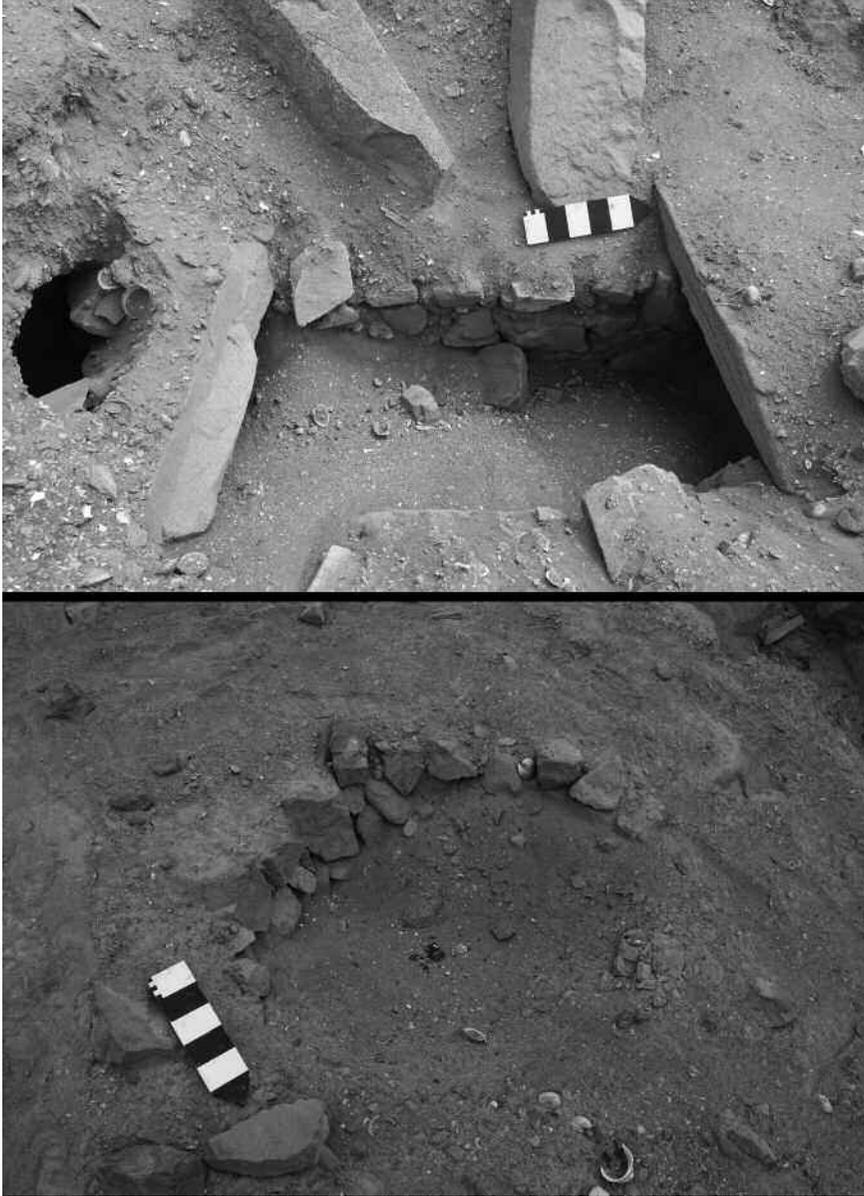


Figure 7. Exposed stone-lined tombs from looted cemeteries along the Tambo-Ilo coast. A rectangular tomb is visible at the site of Callango (top) while a circular tomb is exposed at the site of Alfaro (bottom).

Tomb Context. In the Ilo Valley, El Yaral, Chiribaya Alta, and Chiribaya Baja have formally bounded cemeteries adjacent to residential terraces. The burials at San Gerónimo, on the other hand, were recovered largely from midden contexts. This difference may indicate that the ancestors at the latter site were not being utilized as a corporate manifestation of resource control (Buikstra 1995:258).

It has been argued that the population at San Gerónimo had an economic focus on marine resources based upon grave goods (Buikstra 1995) and dietary reconstruction (Tomczak 2003). It is possible that the rich littoral resources at the coast obviated the need to signal corporate ownership or control of those resources. Arable land, however, is more circumscribed and requires a significant

Table 3. Areal Extent of Chiribaya Cemeteries in the Ilo Region.

Location	Intervalley		References
	Coast (m ²)	Ilo Valley (m ²)	
Chuza	600		Umire Alvarez 1996
Carrizal	1100		estimate from average size of all other coastal springs
Alastaya	1100		estimate from average size of all other coastal springs
Pocoma	1100		estimate from average size of all other coastal springs
Pocoma	1100		estimate from average size of all other coastal springs
Pocoma	1100		estimate from average size of all other coastal springs
Alfaro	690		Umire Alvarez 2006
Higocinto	1017		Umire Alvarez 2006
Callango	8576		Umire Alvarez 2006
Callango	3630		Umire Alvarez 2006
Yerba Buena	1250		Umire Alvarez 2006
Amoquinto	600		Umire Alvarez 2006
Cola de Zorro	314		Umire Alvarez 2006
Cola de Zorro	79		Umire Alvarez 2006
Cola de Zorro	600		Umire Alvarez 2006
TI-188	170		Umire Alvarez 2006
TI-188	120		Umire Alvarez 2006
TI-195	880		Umire Alvarez 2006
Cocotea	1256		Umire Alvarez 2006
Cocotea	600		Umire Alvarez 2006
Cocotea	225		Umire Alvarez 2006
Cocotea	160		Umire Alvarez 2006
Cocotea	225		Umire Alvarez 2006
Pacae	1962		Umire Alvarez 2006
San Gerónimo II		3493	Owen 1993
San Gerónimo		1046	Owen 1993
Chiribaya Baja		2952	Owen 1993
Chiribaya Baja		5481	Owen 1993
Chiribaya Baja		1043	Owen 1993
Algodonal		1925	estimated from map in Owen 1993
Site 222		2844	Owen 1993
Loreto Viejo		1816	Owen 1993
Loreto Viejo		3217	Owen 1993
Site 237		2000	estimated from map in Owen 1993
Chiribaya Alta		7967	Owen 1993
Chiribaya Alta		9754	Owen 1993
Chiribaya Alta		5564	Owen 1993
Chiribaya Alta		4977	Owen 1993
Chiribaya Alta		9972	Owen 1993
Chiribaya Alta		14436	Owen 1993
Chiribaya Alta		7631	estimated from average of all Chiribaya Alta cemeteries
Chiribaya Alta		749	Owen 1993
El Yaral		2200	estimate from map in Buikstra 1995
El Yaral		900	estimate from map in Buikstra 1995
Total	28454	89967	

Note: Estimates were generated for those cemeteries whose areas were not originally reported, or for those whose areas were combined with much larger domestic areas.

investment of time and energy, leading to the creation of bounded cemeteries as indicators of control (Goldstein 1976).

Among intervalley coastal springs like Chuza, Zaro (2007) has argued that the proximity of traditional resource zones (e.g., lomas, arable land,

marine resources) may not have necessitated economic specialization among those Chiribaya communities but, rather, encouraged intensive management of a mixed subsistence economy. If we are to accept the relationship between burial context and corporate resource control mentioned

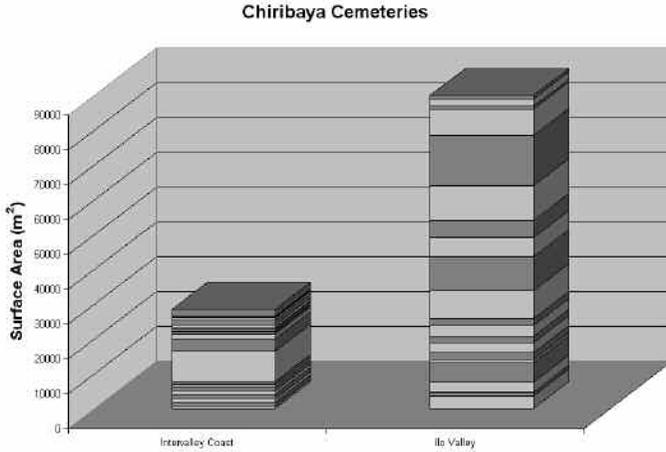


Figure 8. Comparison of looted cemeteries (m²) among intervalley Chiribaya and Ilo Valley Chiribaya mortuary landscapes.

above, it is interesting to note that Chuza burials were found within both small midden contexts and domestic contexts (adjacent to, within, or beneath remnants of domestic architecture). Hence, it appears that the economic diversity among intervalley Chiribaya may have relaxed the need for strict material expressions of corporate resource control, resulting in the placement of tombs in mixed domestic and midden contexts within a single cemetery.

There is also a spatial pattern to the distribution of lined vs. unlined tombs within the Chuza cemetery. Those interspersed with small domestic midden features (found exclusively on the western extent of the excavated area) have stone-lined walls,

while those associated with architectural features (all but one of these features are found in the eastern half of the excavated area) are unlined. This pattern may relate to the stability of the surrounding matrix: Midden deposits are notoriously porous and unstable, perhaps rendering stone-lined tombs most effective when creating burial pits in these areas. Regardless, all tomb forms discussed below (i.e., circular, rectangular, irregular) are represented in each of these areas.

Tomb Form. Tomb form serves as an important mortuary attribute when making comparisons among Ilo Valley Chiribaya, as there are significant differences in tomb form distributions between these populations (Buikstra 1995). In the lower

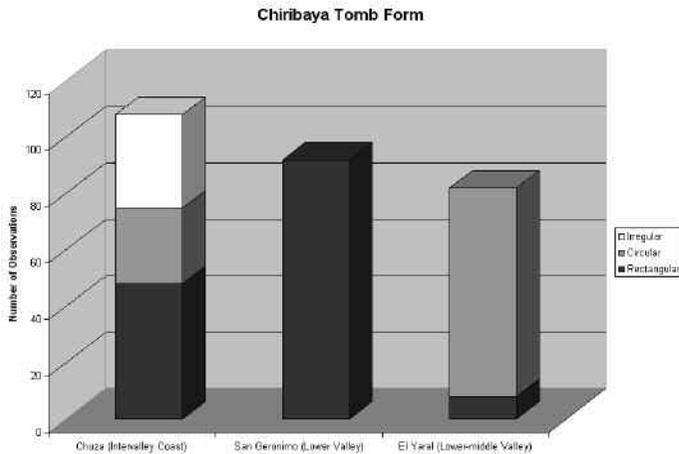


Figure 9. Comparison of Chiribaya tomb form among intervalley (Chuza), lower valley (San Gerónimo), and lower portion of the middle valley (El Yaral) mortuary landscapes.

portion of the middle valley, circular to oval cists predominate at the site of El Yaral, with only eight examples of rectangular tombs. This distribution leads Buikstra (1995:258) to suggest that the mortuary behavior at El Yaral resembles earlier mid-valley tomb forms. On the other hand, rectangular tombs are common in coastal valley Chiribaya cemeteries (Buikstra 1995:258). At San Gerónimo, for instance, just a few hundred meters from the coast, all 92 excavated tombs were rectangular. Contrary to what is observed among these Ilo Valley sites, there is no dominant tomb type at Chuza. Rectangular tombs are more common ($n = 47$, or 44 percent), but circular tombs are also well represented ($n = 27$, or 25 percent). There are an additional 34 irregular tombs (31 percent) that could not be easily classified into these categories (Figure 9).⁴ This variability within the Chuza cemetery may reflect the mixed strategies inherent among intervalley coastal villages that embraced both farming (typically valley-centric) and maritime (typically littoral/coastal-centric) activities.

Grave Accompaniments. There is significant regional variability in the quantity of grave goods among Ilo Valley Chiribaya sites. Tombs at El Yaral were not particularly rich (i.e., quantity of material inclusions), while at San Gerónimo they included an average of more than 30 grave items per tomb (Buikstra 1995:259). At Chiribaya Alta, many tombs contained numerous ceramics, tools, and ornaments. Most notably, Burial #419, which contained one adult male and two adult females, included a total of 32 ceramic vessels, 20 baskets, 25 textiles, and six metal items (Buikstra 1995:260). Strontium isotope analyses of the male produced a local Ilo Valley signature (Knudson and Buikstra 2007:576), and he has been described as a potential paramount lord (Lozada and Buikstra 2005).

While not quite as lavish, the richness and diversity of mortuary assemblages at Chuza are comparable to those of Ilo Valley centers. For instance, Burial #3, a rectangular tomb with a double interment of an adult and child, contained 20 ceramic vessels in addition to bone and lithic artifacts. Similarly, Burial #6, a rectangular tomb containing two children, included 17 ceramic vessels, one miniature balsa raft, and several baskets (Figure 10). Elsewhere, the irregularly shaped tomb of Burial #39 contained a single adult with 13 ceramic ves-



Figure 10. Burial #6 at Chuza showing richness of grave assemblage.

sels, two textiles, a wind instrument, a small raft, animal bones, and marine shells, among other items. A number of Chuza burials also contained examples of four-cornered hats. The individual in Burial #39, for instance, was buried with a red four-cornered hat decorated with three small copper plates. Four-cornered hats have also been recovered from Chiribaya Alta in the Ilo Valley, a settlement argued to be the center of Chiribaya political authority. Farther inland along the Moquegua River, there appears to be a correlation between four-cornered hats and tabular forms of cranial modification among earlier Tiwanaku settlers (Blom 2005; Janusek 2004, 2008). Among Chiribaya settlements, Lozada and Buikstra (2005:216) argue that tabular forms of cranial modification are most commonly associated with valley agriculturalists.

The material artifacts recovered from the Chuza

cemetery underscore two points relative to our argument. First, the richness and diversity of grave goods demonstrate that intervalley coastal populations during the late Chiribaya period were neither peripheral nor marginalized. Although Chuza lies on the small end of the intervalley spectrum of cemetery sizes (i.e., 600 m²), its mortuary assemblage suggests that these populations, through either direct production or exchange, had access to the quantity and quality of polychrome ceramic vessels and other materials typically invested in Ilo Valley tombs. Second, material indicators of economic activity point toward diversification and mixed subsistence strategies. Evidence of economic diversity includes the recovery of artifacts traditionally associated with an emphasis on maritime resources (e.g., harpoons, miniature balsa rafts, and marine shells), while an abundance of camelid bones may suggest exploitation of the surrounding lomas for grazing. The presence of stone-faced terraces associated with the Chuza site also points to farming as a significant activity as well. Finally, if items like four-cornered hats correlate to valley agriculturalists, then the presence of four-cornered hats like that of Burial #39 at Chuza represents a degree of socioeconomic integration between intervalley and main valley people.

Discussion and Conclusion

While most research along the Andean coast is restricted to primary river drainages and their canalized extensions, our work suggests that Chiribaya living along the Tambo–Ilo intervalley coast were numerous during the thirteenth and fourteenth centuries and anything but marginal. These regularly dispersed populations were organized into smaller villages and managed smaller farmsteads, but combined, they formed a significant segment of the Chiribaya cultural landscape. Today, the area may indeed be identified as marginal, since resident populations are all but absent, agricultural production is considerably diminished, and the inland hills have become highly desiccated. We believe that this barren state of the region has unfortunately shaped contemporary human perspectives on its value and importance in the more ancient past. The combination of a rich marine resource base (both offshore and littoral), a productive inland lomas, and an intensively agro-engineered intervalley landscape

was likely more self-sustaining than the Ilo Valley by providing resident populations with an opportunistic mixed economic strategy. The strength of the archaeological expression of Chiribaya across the intervalley landscape also points to a complex degree of socioeconomic organization within the Chiribaya *señorío*. These results suggest that ancient populations were not simply restricted to primary river drainages along the western Andean watershed but, rather, significant segments of a population could intensively engineer intervalley landscapes into regional subsistence economies in a manner that was substantially different from that of their river valley neighbors.

These sorts of expressions of human ingenuity are found beyond the canalized extensions of other western Andean river valleys, though they often receive less attention by scholars. One exception is the Lomas de Atiquipa region, situated about 350 km north of the Tambo–Ilo area between Quebrada de Chala and the Yauca River of southern Peru. Similar to the Tambo–Ilo coast, inland hills there reach heights above 1,200 m asl in a short horizontal distance from the sea, while the general slope and aspect of the terrain create favorable conditions for lomas vegetation, where winds predominately carry moisture from the south to intersect with ground surfaces above 250 m asl. Condensation of this moisture supports the growth of herbaceous plants and trees, which in turn compounds favorable conditions for vegetation by providing ground cover and shade, further reducing evapotranspiration and enhancing soil moisture retention (Canziani 1998). While the lomas today support about 2,190 ha of forested area, spring-fed canals irrigate about 350 ha of cultivated terrain that includes the production of fruit trees, alfalfa, and maize (CIZA-ONERN-SENAMHI 1989). It has been argued that the desertification of these lomas occurred in large part due to deforestation and overgrazing since the Spanish colonial period, but they have been partly regenerated over the past four decades with the development of *atrapanieblas*, or fog catchers, to provide irrigation water for the initial reestablishment of endemic vegetation. Once mature, these standing forests serve as living *atrapanieblas* in these coastal ecosystems (Canziani 1998; Talavera et al. 2005).

While the Lomas de Atiquipa and the Tambo–Ilo coast continue along very different trajectories today and with different cultural values placed upon

them, they do share comparable human components and land-use histories during the late prehispanic and Spanish colonial periods, varying only in degree rather than kind. The Lomas de Atiquipa exhibits similar ecological zones as the Tambo-Ilo region in the arid littoral, alluvial plains, and inland lomas. The archaeological record of the region points to numerous late prehispanic villages in these various zones, such as Quebrada de la Vaca and La Caleta along the littoral and Cahuamarca among the inland hills. Furthermore, extensive tracts of abandoned stone-faced terraces situated below about 300 to 400 m asl testify to the region's intensive agricultural past. From preliminary observation, Canziani (1998:177) estimates that spring-fed canals and stone-faced terraces transformed about 2,600 ha of arid terrain into a productive agricultural landscape in antiquity. In this case, the intersection of microenvironmental conditions and human ingenuity produced a highly engineered landscape that rendered it a focal point of a mixed subsistence strategy among late prehispanic coastal populations situated beyond the hydrological limits of primary river drainages.

We believe that, while admittedly on a much smaller scale, the Tambo-Ilo coast represents a similar configuration that provided late prehispanic coastal populations a rewarding alternative to simply valley-focused or coastal-focused subsistence strategies. In many ways, the management of lomas, agricultural, and marine resource bases by intervalley coastal people is more reminiscent of highland strategies embedded within the concept of ecological complementarity than socioeconomic models of horizontal exchange that have typically characterized the Andean coast. The upland lomas may have provided grasslands for grazing and considerable winter moisture for dry farming, while freshwater springs situated among lower alluvial plains offered the potential for intensive canal and terrace agricultural strategies. Finally, the rocky coastline with intermittent sandy beaches provided an ideal setting for managing the rich littoral and offshore resource bases. Similar to highland communities that managed field plots among a variety of temperature and precipitation gradients in the Andes, intervalley coastal Chiribaya may have reduced risk and secured a degree of self-sufficiency by engineering these vertically stacked intervalley resource potentials into a complex sub-

sistence economy.

A comparison of these ancient landscapes to their contemporary conditions may also point to significant environmental change on timescales ranging from centuries to millennia. As demonstrated here, the mixed resource base of the Tambo-Ilo coast was intensively managed during the thirteenth and fourteenth centuries and supported a significant resident population. Today it is an industrialized wasteland with apparently little biological potential. While the rate, timing, and agents of ecological change remain unclear, it is evident that significant changes have occurred over the past five or six centuries. Clearly, moisture was more available in the past, where freshwater springs sustained enough discharge to be directed through long irrigation canals and into terraced field systems. Local aquifers during the late prehispanic period likely benefited substantially from 900 years of increased El Niño activity prior to the sixteenth century, as Magilligan et al. (2008) have indicated from their Moquegua Valley study. A few farmsteads today continue to be irrigated by freshwater springs, but other terraced field systems lie abandoned as springwater continues to flow nearby. Still other springs have diminished completely. In the context of global change, archaeologists can thus play a central role in investigations of ecological dynamics on multiple temporal and spatial scales (see also Beresford-Jones et al. 2009). In southern Peru, we hope that our continued focus on human agency and environmental change will clarify that process as it unfolded over the past millennium and provide a much needed historical ecological context for the marginality that characterizes the region today.

We believe that the desiccated and industrialized nature of the Tambo-Ilo intervalley landscape has led not only to its marginality and devaluation on a scholarly level but also to its marginality among contemporary communities in the region. Few residents in the Ilo area identify with the historical significance of this landscape. The archaeological record of the lower valley and coast points to a significant population collapse after the late Chiribaya period, where numbers remained deflated until the striking growth of Ilo in the last half of the twentieth century with the establishment of the Southern Peru Copper Corporation (Hall 1992; Zaro 2005b). Importantly, a compari-

son of historical documents of the early twentieth century (Paernio 1908) to historic aerial photographs of the mid-twentieth century indicates that many spring systems near Ilo were already experiencing a sharp decline (and therefore a decline in agricultural importance) well before the population boom catalyzed in part by SPCC (Zaro 2005b:201). Consequently, only a small percentage of Ilo residents has historic ties to the area prior to the twentieth century, when the region's agroecological past was more pronounced.

Our reference to *tierras olvidadas*, or forgotten lands, thus has dual meanings. It refers to the lack of historical connection to these intervalley landscapes by contemporary peoples of the Ilo region but also to their perceived unimportance within scholarly communities, at least relative to adjacent, more populated areas. This study illuminates the potential for some of these marginalized environments to significantly alter our perceptions and understanding of the complexity, breadth, and diversity of human ingenuity in resource management and the processes of socioenvironmental change beyond the hydrological limits of arid western Andean river valleys.

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Notes

1. Combined, the Moquegua and Ilo rivers (plus upper tributaries) constitute the Osmore drainage; the Moquegua River flows through the middle portion, while the Ilo River flows through the lower and coastal portions.
2. Because of the difficulties of delineating the areal extent of habitation areas, midden deposits, and debris scatters from surface remains alone, we have chosen not to include survey data pertaining to these features in this discussion. These were recorded differentially among the several archaeological projects that have produced reconnaissance data over the past several decades, largely stemming from the integrity of the archaeological record itself. Therefore, we include only a comparative discussion of Chiribaya mortuary features.
3. Since intervalley coastal surveys generated only surface data, we felt it prudent to utilize only original surface data generated in the Ilo Valley survey for comparison (Owen 1994) rather than Ilo Valley excavation data from Buikstra (1995). While excavation data provide a more precise measure of the areal extent of a cemetery (and number of interments), comparison of looted cemeteries to other looted cemeteries from surface evidence alone may provide a more valid measure of *relative* differences.
4. In this study, “circular” includes circular, oval, and semicircular tomb forms as initially recorded in Miranda and Umire Alvarez 2007, while “rectangular” includes rectangular, quadrangular, and semirectangular tomb forms as they were initially recorded.

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